

## WHAT IS CLAIMED IS:

1 1. A method for depositing a film on a substrate in a chamber comprising:  
2 adjusting a temperature of said substrate to a first temperature;  
3 introducing a first reactant gas into said chamber;  
4 adsorbing substantially at least one monolayer of said first reactant gas onto said  
5 substrate;  
6 evacuating any excess of said first reactant gas from said chamber;  
7 adjusting a temperature of said substrate to a second temperature;  
8 introducing a second reactant gas into said chamber to react with said first  
9 reactant gas to produce said film on said substrate;  
10 evacuating any excess of said second reactant gas from said chamber; and  
11 adjusting a temperature of said substrate to a third temperature.

1 2. The method of claim 1, wherein the method is repeated, without the step  
2 of adjusting a temperature of said substrate to a first temperature, to deposit an  
3 additional film layer.

1 3. The method of claim 1, wherein said second temperature is greater than  
2 said first temperature and said third temperature.

1 4. The method of claim 3, wherein said first temperature is between about –  
2 40 °C and 300 °C.

1 5. The method of claim 4, wherein said first temperature is between about 20  
2 °C and 200 °C.

1 6. The method of claim 3, wherein said second temperature is between about  
2 200 °C and 600 °C.

1 7. The method of claim 3, wherein said third temperature is between about  
2 20 °C and 200 °C.

1 8. The method of claim 1, wherein a temperature ramp rate occurring  
2 between said first temperature and said second temperature is at least 200 °C per  
3 second.

1 9. The method of claim 1, wherein a temperature ramp rate occurring  
2 between said second temperature and said third temperature is at least 100 °C  
3 per second.





1 20. The method of claim 16, wherein said high pressure is between about 3  
2 and 20 torr.

1 21. The method of claim 16, wherein said low pressure is less than 3 torr.

1 22. The method of claim 16, wherein said low pressure is less than 1 torr.

1 23. The method of claim 16, wherein said energy source is selected from a  
2 group consisting of a rapid thermal processor, a laser, an electron beam source,  
3 and an x-ray source.

1 24. The method of claim 16, wherein said substrate temperature is  
2 additionally affected by resistively heating said pedestal.

1 25. The method of claim 16, wherein said substrate temperature is  
2 additionally affected by flowing a chilled fluid through said pedestal.

1 26. A system for controlling a temperature of a substrate in an atomic layer  
 2 deposition system, said system comprising:  
 3 a deposition chamber;  
 4 a vacuum pump coupled to said deposition chamber;  
 5 a substrate holder located within said deposition chamber, said substrate  
 6 holder having a passageway for flowing a backside gas into a space between  
 7 said substrate holder and said substrate on said substrate holder;  
 8 a gas inlet coupled to said deposition chamber; and  
 9 an energy source for heating by irradiation said substrate on said substrate  
 10 holder.

1 27. The system of claim 26, further comprising a means for valving and  
 2 controlling a pressure of said backside gas.

1 28. The system of claim 26, wherein said substrate holder is an electrostatic  
 2 chuck.

1 29. The system of claim 28, wherein said electrostatic chuck has a means for  
 2 flowing a fluid therein.

1 30. The system of claim 29, wherein said electrostatic chuck has a cooling  
2 capacity of between about 200 W/m<sup>2</sup> °K and 350 W/m<sup>2</sup> °K.

1 31. The system of claim 29, wherein said electrostatic chuck has a cooling  
2 capacity of at least 200 W/m<sup>2</sup> °K.

1 32. The system of claim 28, wherein there is a space between said substrate  
2 and said electrostatic chuck.

1 33. The system of claim 26, wherein said energy source for heating said  
2 substrate is a rapid thermal processor.

1 34. The system of claim 33, wherein said substrate is heated with a  
2 temperature ramp rate of about between 100 °C per second and 300 °C per  
3 second.

1 35. The system of claim 33, wherein said substrate is heated with a  
2 temperature ramp rate of at least 100 °C per second.

1 36. The system of claim 33, wherein a source for said rapid thermal processor  
2 is a graphite heater.

1 37. The system of claim 33, wherein a source for said rapid thermal processor  
2 is a plasma arc.

1 38. The system of claim 33, wherein a source for said rapid thermal processor  
2 is at least one tungsten halogen lamp.

1 39. The system of claim 26, wherein said energy source is selected from the  
2 group consisting of a laser, an electron beam source, and an x-ray source.

1 40. The system of claim 39, wherein said substrate is heated with a  
2 temperature ramp rate of about between 200 °C per second and 700 °C per  
3 second.

1 41. The system of claim 39, wherein said substrate is heated with a  
2 temperature ramp rate of at least 200 °C per second.

1 42. The system of claim 39, further comprising a means for scanning an  
2 output of said energy source over a surface of said substrate.

1 43. The system of claim 39, further comprising a means for scanning said  
2 substrate relative to an output of said energy source.



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1 44. A method for depositing a film on a substrate in a chamber comprising:  
2 adjusting a temperature of said substrate to a first temperature and introducing a  
3 first reactant gas into said chamber to adsorb substantially at least one  
4 monolayer of said first reactant gas onto said substrate before evacuating any  
5 excess of said first reactant gas from said chamber; and  
6 adjusting a temperature of said substrate to a second temperature and  
7 introducing a second reactant gas into said chamber to react with said first  
8 reactant gas to produce said film on said substrate before evacuating any excess  
9 of said second reactant gas from said chamber.

1 45. The method of claim 44, wherein the method is repeated to deposit  
2 additional film layers.

1 46. The method of claim 44, wherein said second temperature is greater than  
2 said first temperature.

1 47. The method of claim 44, wherein a temperature ramp rate occurring  
2 between said first temperature and said second temperature is at least 200 °C per  
3 second.

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1 48. A system for depositing a film on a substrate in a chamber comprising:  
2 a means for adjusting a temperature of said substrate to a first temperature;  
3 a means for introducing a first reactant gas into said chamber;  
4 a means for adsorbing substantially at least one monolayer of said first reactant  
5 gas onto said substrate;  
6 a means for evacuating any excess of said first reactant gas from said chamber;  
7 a means for adjusting a temperature of said substrate to a second temperature;  
8 a means for introducing a second reactant gas into said chamber to react with  
9 said first reactant gas to produce said film on said substrate;  
10 a means for evacuating any excess of said second reactant gas from said  
11 chamber; and  
12 a means for adjusting a temperature of said substrate to a third temperature.

1 49. The system of claim 48, wherein said means for adjusting a temperature of  
2 said substrate to a first temperature, said means for adjusting a temperature of  
3 said substrate to a second temperature, and said means for adjusting a  
4 temperature of said substrate to a third temperature is selected from the group  
5 consisting of ions, electrons, photons, and thermal energy.

1 50. The system of claim 49, wherein said means for adjusting a temperature of  
2 said substrate to a first temperature, said means for adjusting a temperature of  
3 said substrate to a second temperature, and said means for adjusting a  
4 temperature of said substrate to a third temperature utilize an energy source  
5 selected from a group consisting of a rapid thermal processor, a laser, an electron  
6 beam source, and an x-ray source.

1 51. The system of claim 48, wherein said third temperature equals said first  
2 temperature.